Module 24
Conditions Affecting Capacity

Learning Objectives

By the end of this section, you will:

1. Be aware of problems caused by off-level conditions.
2. Know the results of rapid boom swinging.
3. Understand static, dynamic and shock load and explain the significance.
4. Know how swing radius affects capacity.
5. Know the situations that cause cranes to be in duty cycle operations.

Because cranes do not typically operate under optimum conditions, all factors must be considered to ensure safe operations.

Safety is always the number one priority.

Off-level

Off level conditions create many problems.

What are some of the concerns?

» Side loading on the boom.

» Loss of swing radius.

» Extra stress on turntable and other components.

Approximate chart capacity lost when crane is out of level by:

Boom Lift and Lift Radius	1°	2°	3°
Short Boom, Minimum Radius	10%	20%	30%
Short Boom, Maximum Radius	8%	15%	20%
Long Boom, Minimum Radius	30%	41%	50%
Long Boom, Maximum Radius	5%	10%	15%

The loss in load radius can be significant for off-level cranes.

Approximately how much chart capacity is lost when the crane with a long boom and minimum radius is out of level by three degrees?

» 50%

Duty Cycle

Duty cycle capacity reductions apply to cranes operating in a continuous high speed operations, such as:

» Clamming.

» Concrete placing.

» Magnet work.

High speed operation imposes greater stress on the crane, components and rigging. Impact loading, high speed load swing out, and boom side loading are frequent and reasons for capacity reduction.

Cranes operating in duty cycle may be down rated by approximately 20%. Always check manufacturers recommendations.

Dynamic Loads

The load chart reflects not only ideal conditions but also a static load condition where no movement is involved.

Dynamic load refers to stresses and forces imposed on crane components due to moving the load.

Movement includes hoisting, lowering, stopping, and swinging. Static load is a condition indicating the load is being suspended without movement. Dynamic load increases as movement of the load increases.

Impact loading can cause severe problems. What situations could cause impact loading?

» Rapid acceleration.

» Sudden stopping.

» Sudden load release.

» Sudden load snatching.

» Pick and carry operations.

Side loading

All booms are affected by side loading when load is positioned to one side of the boom.

Side loading affects both lattice and hydraulic booms. Lattice booms have an allowance of 2% for a side load or 2 ft. in 100 ft. booms.

Structural failure and equipment damage can rapidly occur from excessive side loading.

Load hoist line must remain vertical to ensure accuracy of load chart rating.

Rapid swinging of the boom creates side loading, an increase in radius and centrifugal force problems.

Rapid swinging of the boom:

- Creates side loading.
- Causes increase in radius as load swings out creating stability problems and reduced capacity.
- Causes centrifugal force problems that can be excessive and uncontrollable.

Several conditions can create radius increase:

- Hooking up to load outside of boom tip.
- Hooking up to load inside of boom tip.
- Boom deflection.

Boom deflection is magnified on tire mounted equipment.

Weather

Wind effect on a crane can be severe, especially on long boom configurations.

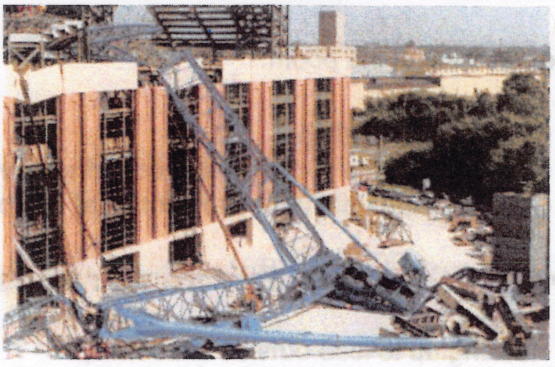
- Wind can push a boom and/or the load sideways causing side loading.
- Wind blowing from behind the crane pushes the load out from crane therefore increasing the load radius.
- Long booms with high boom angles can be blown over backwards because of wind loading.

Adverse conditions reduce a crane's maximum gross capacity.

Capacity limits stated on the load chart must be assumed to be the maximum gross capacity and must be reduced to compensate for any adverse conditions. All factors that can affect the crane's capacity must be considered. All adverse conditions will have an effect on the crane's capacity and must be reflected as a reduction in total capacity.

Case Study: The Fall of Big Blue

The Lampson Transi-Lift 3 crane was working for Mistubishi Heavy Industries of America as part of its contract to build the Miller Park convertible roof. It was one of about 10 cranes of this size in the world, and the largest in North America. Miller Park workers nicknamed it Big Blue.



Crane cost: $ 10 million
Main boom length: 280 feet
Overall length: 540 feet
Machine weight: 2100 tons
Lifting capacity: 1500 tons
Counterweight: 1150 tons
Assembly time: 6 weeks
Truckloads of parts: 150
Operators: 4

The collapse was complete in seconds. The damage to the main part of the stadium appeared great, as did the ruin of the roof struck by the mighty crane that was to build it. Big Blue by this time was a jumble of oversized erector-set pieces, strewn at random over the construction site.

Consequences:

- Three iron workers were killed when the personnel platform they were in was hit by the falling crane.
- $200 million dollars in damage.
- Job completion delayed by one year.

Investigations:

Investigations conducted by government and private organizations concluded that wind force on the load was the critical factor that caused the accident. According to the manufacturer, the crane should NOT be operated in winds above 15 miles per hour. At the time of the accident, winds were estimated to be 32 miles per hour.

Clean-up:

A Demag CC-12600 (lifting capacity of 1,600 tons) was brought in to clean up the mess and complete the job. DEMAG CC-12600 PROFILE:

MACHINE COST: $ 11 MILLION
BOOM LENGTH: 525 FEET
MACHINE WEIGHT: 2200 TONS (4,400,000 lbs.)
LIFTING CAPACITY: 1600 TONS (3,200,000 lbs.)
COUNTER WEIGHT: 1200 TONS (2,400,000 lbs.)
WIRE ROPE REQUIRED: 32,000 FEET
ASSEMBLY TIME: 5 WEEKS
TRUCK LOADS OF COMPONENTS: 159
OPERATORS REQUIRED: 4